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# P89 - Electric Force Microscopy Characterization of Ion Beam microfabricated Graphitic Channels in single crystal diamond

*Friday, 11 July 2014 13:00 (1 hour)*

The possibility of fabricating sub-superficial graphitic microchannels in diamond offers several promising opportunities in the fields of cellular bio-sensing [1] and particle radiation [2].
In this work, we present an investigation by Electric Force Microscopy (EFM) of a graphitic microchannel fabricated by using a 1.8 MeV He+ microbeam scanning over the surface of a single-crystal diamond. A linear pattern (50 μm wide and 1 mm long) was irradiated at a fluence well above the graphitization threshold. Before the implantation process, the diamond's surface were covered with a copper layer in order to reduce the ion penetration depth without modifying the beam energy, choosing in this way the depth of the highly-damaged layer from the diamond surface. Further metal deposition of variable-thickness masks was then realized in order to implant channels with emerging end-points [3]. High temperature annealing was performed in order to induce the graphitization of the highly damaged buried region.

The presence of a conductive channel, buried at a depth of 1 μm, was clearly evidenced, in the presence of current flowing in the channels, by maps of the electrical potential of the surface region overlying the channel. The electric potential is measured collecting for every position the potential that minimize the electrical force probed by the conductive microtip. Moreover, the electric potential profiling shows regions of opposite contrast located at different distances from the channel'endpoints. This effect is attributed to the dissimilarity between the electrical resistance path on the graphitic microchannel and the electrical resistance path on the superficial conductive layer induced by the high thermal annealing.
The results have significant implications for future fabrication of all-carbon graphite/diamond devices, both in the fields of cellular biosensing and radiatieon detection.

[1] F. Picollo et al., Advanced Materials 25 (2013) 4696
[2] J. Forneris et al., Nuclear Instruments and Methods in Physics Research B 306 (2013) 169
[3] F. Picollo et al., New Journal of Physics 14 (2012) 053011

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